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Glossary of key genes and microRNAs

Gene nomenclature follows the recommendations of the HUGO Gene Nomenclature Committee (HGNC; www.genenames.org). MicroRNAs are designated according to miRBase (www.mirbase.org). Table 2 provides the verified HGNC identifiers.

Table 2. Glossary of genes and microRNAs with HGNC / miRBase identifiers

Symbol (HGNC)	HGNC ID / synonyms	Name	Functional significance
<i>PPARGC1A</i>	HGNC:9237; NCBI:10891; OMIM:604517; synonyms: <i>PGC-1α</i> , <i>PGC1A</i> , <i>PPARGC1</i>	PPARG coactivator 1 alpha	Central transcriptional coactivator; main regulator of mitochondrial biogenesis, oxidative metabolism, and aerobic exercise adaptation
<i>PDK4</i>	HGNC:8812; NCBI:5166; OMIM:602527; synonyms: <i>PDHK4</i>	Pyruvate dehydrogenase kinase 4	Regulation of metabolic switching from carbohydrates to fats; key gene of energy metabolism in skeletal muscle
<i>PPARD</i>	HGNC:9235; NCBI:5467; OMIM:600409; synonyms: <i>PPAR-δ</i> , <i>NR1C2</i> , <i>NUC1</i> , <i>PPARB</i>	Peroxisome proliferator activated receptor delta	Nuclear receptor regulating fatty acid oxidation and type I fiber formation; modulator of endurance
<i>ACTN3</i>	HGNC:165; NCBI:89; OMIM:102574; synonyms: <i>ACTN3D</i>	Actinin alpha 3	Structural Z-disc protein of fast-twitch muscle fibers; the R577X polymorphism is associated with speed-power performance
<i>MYH7</i>	HGNC:7577; NCBI:4625; OMIM:160760; synonyms: <i>CMH1</i> , <i>MPD1</i> , <i>MYHCB</i> , <i>β-MHC</i>	Myosin heavy chain 7	Myosin heavy chain of slow (type I) skeletal fibers and myocardium; determines contractile characteristics
<i>SLC16A1</i>	HGNC:10922; NCBI:6566; OMIM:600682; synonyms: <i>MCT</i> , <i>MCT1</i>	Solute carrier family 16 member 1	Lactate transport across cell membranes; key regulator of lactate metabolism during exercise
<i>VEGFA</i>	HGNC:12680; NCBI:7422; OMIM:192240; synonyms: <i>VEGF</i> , <i>VPF</i>	Vascular endothelial growth factor A	Primary inducer of angiogenesis; sensitive to hypoxia and mechanical stress; ensures muscle capillarization with training
<i>HIF1A</i>	HGNC:4910; NCBI:3091; OMIM:603348; synonyms: <i>HIF-1α</i> , <i>MOP1</i> , <i>PASD8</i> , <i>bHLHe78</i>	Hypoxia inducible factor 1 subunit alpha	Main transcriptional regulator of adaptation to hypoxia; activated during intense exercise

Table 2 (continued)

Symbol (HGNC)	HGNC ID / synonyms	Name	Functional significance
<i>BDNF</i>	HGNC:1033; NCBI:627; OMIM:113505; synonyms: ANON2, neurotrophin	Brain derived neurotrophic factor	Regulation of neuroplasticity; level increases with aerobic exercise; associated with cognitive effects of sports
<i>COMT</i>	HGNC:2228; NCBI:1312; OMIM:116790; synonyms: <i>HEL-S-98n</i>	Catechol-O-methyltransferase	Degradation of catecholamines; the Val158Met polymorphism modulates neuromuscular regulation and pain sensitivity
<i>GRIK2</i>	HGNC:4580; NCBI:2898; OMIM:138244; synonyms: <i>GluR6</i> , <i>GLUR6</i>	Glutamate ionotropic receptor kainate type subunit 2	Subunit of the ionotropic kainate glutamate receptor; hypomethylation is associated with epigenetic memory of skeletal muscle and hypertrophy
<i>TRAF1</i>	HGNC:12031; NCBI: 7185; OMIM:601711; synonyms: <i>EBI6</i>	TNF receptor associated factor 1	Adapter of TNF/NF- κ B signaling cascades; hypomethylation persists for 22 weeks after resistance exercise — marker of epigenetic memory
<i>BICC1</i>	HGNC:19351; NCBI: 80114; OMIM:614295; synonyms: <i>BICC</i>	BicC family RNA binding protein 1	RNA-binding protein; hypomethylation is associated with long-term muscle adaptation to resistance exercise.
<i>STAG1</i>	HGNC:11354; NCBI: 10274; OMIM:604358; synonyms: <i>SA-1</i> , <i>SCC3A</i> , <i>SA1</i>	Stromal antigen 1 (cohesin subunit)	Subunit of the cohesin complex; long-term hypomethylation after exercise
<i>FOXO3</i>	HGNC:3821; NCBI: 2309; OMIM:602681; synonyms: <i>FOXO3A</i> , <i>FKHRL1</i>	Forkhead box O3	Regulation of energy homeostasis, autophagy, oxidative stress, and apoptosis in muscles
<i>CREB5</i>	HGNC:16844; NCBI: 9586; OMIM:618262; synonyms: <i>CRE-BPa</i>	cAMP responsive element binding protein 5	Transcription factor involved in the regulation of muscle hypertrophy and the response to exercise
<i>IGF1</i>	HGNC:5464; NCBI:3479; OMIM:147440; synonyms: <i>IGF-I</i> , <i>MGF</i>	Insulin-like growth factor 1	Key anabolic factor; regulates muscle hypertrophy and regeneration via the IGF-1/Akt/mTOR pathway
<i>PTEN</i>	HGNC:9588; NCBI:5728; OMIM:601728; synonyms: <i>MMAC1</i> , <i>TEP1</i>	Phosphatase and tensin homolog	Negative regulator of the insulin/PI3K/Akt pathway; target of miR-486; altered methylation affects insulin sensitivity
<i>NFE2L2</i>	HGNC:7782; NCBI:4780; OMIM:600492; synonyms: <i>NRF2</i>	Nuclear factor erythroid 2-related factor 2	Main regulator of the antioxidant response; regulates the expression of ROS-detoxifying enzymes
<i>AXIN1</i>	HGNC:903; NCBI:8312; OMIM:603816; synonyms: <i>AXIN</i> , <i>FU</i>	Axin 1	Component of the Wnt/ β -catenin pathway; hypomethylation is part of the “epigenetic signature” of repeated exercise
<i>CAMK4</i>	HGNC:1464; NCBI:814; OMIM:114080; synonyms: <i>CaMKIV</i>	Calcium/calmodulin dependent protein kinase IV	Ca ²⁺ -sensitive kinase; mediator of muscle response to contraction through transcriptional regulation

Table 2 (continued)

Symbol (HGNC)	HGNC ID / synonyms	Name	Functional significance
<i>UBR5</i>	HGNC:16806; NCBI:51366; OMIM:608413; synonyms: <i>EDD</i> , <i>EDD1</i> , <i>HYD</i>	Ubiquitin protein ligase E3 component n-recognin 5	E3 ubiquitin ligase; involved in the regulation of muscle mass and the response to resistance exercise
<i>RPL35A</i>	HGNC:10345; NCBI:6165; OMIM:180468; synonyms: <i>DBA5</i> , <i>L35A</i>	Ribosomal protein L35a	Structural component of the 60S ribosomal subunit; expression increases with repeated exercise
<i>HEG1</i>	HGNC:29227; NCBI:57493; OMIM:614182; synonyms: <i>MEMP</i> , <i>HEG</i>	Heart development protein with EGF-like domains 1	Involved in vascular system development and regulation of the endothelial barrier
<i>PLAAT3</i>	HGNC:17825; NCBI:11145; OMIM:11367; previous symbol: <i>PLA2G16</i> ; synonyms: <i>HREV107</i> , <i>H-REV107-1</i>	Phospholipase A and acyltransferase 3	Phospholipase A/acyltransferase; regulates lipid metabolism in muscle tissue
<i>SETD3</i>	HGNC:20493; NCBI:84193; OMIM:615671;	SET domain containing 3, actin histidine methyltransferase	Actin methyltransferase; involved in the regulation of muscle function
<i>miR-1-1/1-2</i>	miRBase: MI0000651 (hsa-mir-1-1, HGNC: MIR1-1); MI0000437 (hsa-mir-1-2, HGNC: MIR1-2)	microRNA 1-1 / 1-2	Muscle-specific “myomiR”; suppresses hypertrophy; behavior during aerobic exercise is contradictory (see Section 1.3); regulator of cardiac contractility
<i>miR-133a</i>	miRBase: MI0000450 (hsa-mir-133a-1, HGNC: MIR133A1); MI0000451 (hsa-mir-133a-2, HGNC: MIR133A2)	microRNA 133a-1 / 133a-2	Muscle-specific “myomiR”; regulates hypertrophy and cardioprotection (anti-remodeling)
<i>miR-21</i>	miRBase: MI0000077 (hsa-mir-21, HGNC: MIR21)	microRNA 21	Multifunctional; during exercise, improves lipid metabolism (via PDCD4), has cardioprotective effects
<i>miR-29b</i>	miRBase: MI0000105 (hsa-mir-29b-1, HGNC: MIR29B1); MI0000107 (hsa-mir-29b-2, HGNC: MIR29B2)	microRNA 29b-1 / 29b-2	Involved in adaptation to aerobic exercise; regulates fibrosis and connective tissue remodeling
<i>miR-206</i>	miRBase: MI0000490 (hsa-mir-206, HGNC: MIR206); « myomiR»	microRNA 206	Specific to skeletal muscle; involved in muscle tissue regeneration and post-injury recovery
<i>miR-486</i>	miRBase: MI0002470; HGNC: MIR486-1 (hsa-mir-486-1)	microRNA 486-1	Regulates the PI3K/AKT pathway via PTEN; marker of recovery and regeneration; correlates with VO ₂ max

Table prepared by the authors based on data from the internet source www.genenames.org

Note. MicroRNAs are designated according to miRBase www.mirbase.org